Brucella infection in children: Evaluation of 148 pediatric patients

Özlem Özgür Gündeşlioğlu
Deparment of Pediatric Division of Pediatric Infectious Diseases, Faculty of Medicine, Cukurova University, Adana, Turkey

Abstract

Aim: Brucellosis a worldwide infectious zoonotic disease. This study was aimed to evaluate the clinical, demographic characteristics, complications, treatment and follow-up results of pediatric patients diagnosed with brucellosis. Material and Method: The medical records of 148 pediatric patients who were diagnosed with brucellosis were studied retrospectively. Results: Sixty-one female (41.2%), 87 male (58.8%), in total 148 pediatric patients who were diagnosed with brucellosis were included in the study. Among the patients, 64.1% had a history of consuming fresh cheese, 4.1% had a history of consuming raw milk and 16.9% had a history of keeping a Brucella diagnosed animal at home. Brucella history rate in the family members of the patients was determined as 39.2%; and 12.8% of the patients included in the study were asymptomatic. The most common complaint of the patients who were symptomatic was fever (59.5%) followed by arthralgias (41.2%) and leg pain (38.5%). All patients were subjected to standard tube agglutination test and blood culture was taken from 93 patients. B. melitensis in blood culture was positive in 72% of the patients. Osteoarticular involvement developed in 12.1% of the patients; and 1.3% of the patients developed relapses after the end of the treatment. Discussion: Brucellosis is still an endemic disease in Turkey. Brucella can infect all organs and tissues and is a major cause of morbidity. The use of more than one antibiotic in the treatment and long treatment duration reduces patient compliance; thus, close follow-up of the patients is important.

Keywords

Brucella; Osteoarticular Involvement; Pediatric; Treatment

DOI: 10.4328/JCAM.5956 Received: 28.06.2018 Accepted: 28.07.2018 Published Online: 29.07.2018 Printed: 01.01.2019 J Clin Anal Med 2019;10(1): 99-103
Corresponding Author: Özlem Özgür Gündeşlioğlu, Deparment of Pediatric Division of Pediatric Infectious Diseases, Faculty of Medicine, Cukurova University, Adana, Turkey. GSM: +905055677801 E-Mail:ozlemozgur1978@yahoo.com
ORCID ID: 0000-0003-2202-7645

Introduction

Brucella is the most common zoonotic infectious disease in the world. Many species of Brucella have been identified according to phenotypic characteristics, antigenic changes, and frequency of causing infection in different animals. *B. melitensis*, *B. abortus*, *B. suis*, and *B. canis* are the species which are pathogenic for humans. The majority of infections in humans is caused by B. melitensis. Brucella is transmitted by direct contact with infected animal tissues (blood, discarded fetus, uterine secretions and especially placenta) or by the consumption of raw or unpasteurized infected animal products (especially fresh cheese, milk, and dairy products). It can also be transmitted by the inhalation of contaminated aerosol (such as laboratory environment). Although transmission between humans is rare, contamination through blood transfusion, bone marrow transplantation, sexual intercourse and breast milk has been reported [1, 2]. More than 500.000 Brucella infections throughout the world are being reported every year. Due to the low reporting, the exact real numbers are not known, especially in endemic areas. Brucella is frequently observed in the Mediterranean area, which includes Turkey as a part of it, Middle Eastern countries, Middle and South America and Asia [3].

Brucellosis is a systemic infection. This infection can develop in all organs and tissues. However, reticuloendothelial system involvement is the one which occurs most frequently. Clinical symptoms and findings of brucellosis may differ significantly according to the involved organ and are not specific to the disease. Locally osteoarticular involvement is the most frequently observed infection [1, 2]. In this study, we aimed to evaluate the demographic characteristics, complications, treatment and follow-up results of pediatric patients who were diagnosed with brucellosis.

Method and Material

This study was carried out between July 2012 and September 2013 at the Ministry of Health Diyarbakır Children's Hospital, Department of Infectious Diseases Patients under 18 years in whom serum brucella agglutination titre was found to be 1:160 or over with standard tube agglutination test (Wright) and/or whose blood culture was positive for brucellosis were included in this study. Patients' files were studied retrospectively; age of the patients, their gender, the city they came from, the season they were admitted to the hospital, risk factors for brucellosis, the duration of the symptoms, the treatment they have received before admission to the hospital, family history of similar diseases, admission complaints, physical examination findings, laboratory and microbiological examinations [complete blood count, C- reactive protein (CRP), erythrocyte sedimentation rate (ESR), liver function tests, serum Brucella agglutination titration, blood culture] were evaluated and recorded on the inspection form. Standard tube agglutination tests were performed as previously described [4]. Blood culture samples were run with the BACTEC 9120 method.

Osteoarticular involvement was defined as the presence of inflammation symptoms (swelling, pain, dysfunction or function loss, increased temperature, and rash) on any peripheric bone and joint, and/or the presence of deeply located pain in any bone joint which is relieved after rest and the radiological evidence of inflammation on this area. Spondylitis was defined as the presence of radiological (direct X-ray and/or MRI) findings with findings of inflammatory back pain or stiffness on the back. Sacroiliitis was diagnosed with the Fabere test or by direct pelvic compression, along with radiological changes of the sacroiliac joint [5].

In uncomplicated cases, the medication was applied twice daily for 6 weeks, in children above the age of 8, doxycycline 4 mg/kg/day, rifampicin 15-20 mg/kg/day, in children below the age of 8, trimethoprim-sulfamethoxazole 10 mg/kg/day and rifampicin 15-20 mg/kg/day were used. In patients with relapse, intramuscular gentamicin was added to the treatment at a dose of 5-7.5 mg/kg / day for 14 days. In patients with osteoarticular complications such as sacroiliitis or spondylitis, streptomycin was given at 20 mg/kg/day dose for 14 days at the beginning of the treatment. The treatment of the patients with osteoarticular symptoms was continued until the symptoms were relieved and the treatments were completed for at least 12 weeks. Patients were called for the evaluation at the 2nd and 6th weeks of thtreatment, for a monthly evaluation after the end of treatment, and for 3-month evaluation after 3 months. Patients with signs and symptoms of recurrence or who had positive blood culture within one year after the treatment were considered as relapses [2].

Statistics

All analyses were performed using IBM SPSS Statistics Version 20.0 statistical software package. Categorical variables were expressed as numbers and percentages, whereas continuous variables were summarized as mean and standard deviation and as median and minimum-maximum where appropriate. Chi-square test was used to compare categorical variables between the groups. For comparison of continuous variables between two groups, Mann-Whitney U test was used. The statistical level of significance for all tests was considered to be 0.05.

Results

Sixty-one female (41.2%) and 87 male (58.8%) in total 148 pediatric patients were included in this study. The demographic characteristics of the patients are shown in Table 1. In our study, Brucella infection was detected in all seasons. Brucella infection was found to be most common during the summer months (62.1%), with the highest rate in July (29%). Nineteen

Table 1. Demographic characteristics of the participant patients of the study

Demographic characteristics	n	%
Gender		
Female	61	41.2
Male	87	58.8
Age (months)		
Median ± SD	128.5±45.1	
Min	16	
Max	214	
Duration of symptoms pre-admission (days)		
Median ± SD	15±100.6	
Min	0	
Max	730	
Patients with past brucella history	8	5.4
Patients with brucella history in the family	58	39.2
Patients with fresh cheese consumption history	95	
Patients with unpasteurized milk consumption history	6	4.1
Patients with history of keeping sick animals in their homes	25	16.9

(12.8%) of the patients taken into the study were asymptomatic. In 59.5% of the symptomatic patients, fever was the most common complaint followed by arthralgias (41.2%) and leg pain (38.5%). The presenting symptoms of the patients are shown in Table 2. The most common symptom determined at the physical examination of the patients was pallor (21.6%), whereas splenomegaly rate was 15.5% and hepatomegaly rate was 4.7%. Eighteen of the patients (12.16%) had findings of bone joint involvement. Rose Bengal and Brucella tube agglutination test for diagnosis of brucellosis was applied to all the patients. Of all the patients diagnosed with brucellosis rose Bengal and tube agglutination was negative only in one patient; the diagnosis was made with positive bone marrow culture. The culture was taken from 93 patients in the study, and 67 (72%) of the patients were positive for B. mellitensis, and B. mellitensis was isolated from one single patient's bone marrow culture.

In our study, laboratory changes such as neutropenia and thrombocytopenia due to bone marrow involvement were found in 35% of the patients, no hematologic complications such as hemorrhage or coagulation disorder were seen in any of the patients. Asymptomatic transaminase increase was detected in 21.4% of the patients and none of the patients had symptomatic hepatitis clinic. The acute phase reactants of the patients were found to be mildly increased. The laboratory characteristics of the patients included in the study are shown in Table 3.

Osteoarticular involvement was the most frequent (12.1%) local involvement of Brucella. The most frequent (55.5%) osteoarticular involvement form was peripheral arthritis. Arthritis was mostly seen in the knees (30%), hips (30%) and ankles (30%). One of the patients who developed arthritis (10%) had joint involvement in two joints, in the knee and ankle. Complications of Brucella in the study group are shown in Table 4. When patients with osteoarticular involvement were compared to patients without osteoarticular involvement in terms of clinical, demographic and laboratory characteristics, the sedimentation values in patients with osteoarticular involvement were found higher and the difference between the groups was statistically significant ($p < 0,05$).

In our study, seven cases that were diagnosed with sacroiliitis and spondylitis were treated for 12 weeks. The rest of the patients' treatment was completed in six weeks. It was found that eight (5.4%) of the patients in the study had been diagnosed with brucellosis before but had received insufficient treatment. During our study, one of the patients who completed his treatment was considered as a relapse after three months, and another was considered as a relapse after five months. It was found that these cases were noncompliant with the drug.

Discussion

In this study, within a period of about one year in the Southeastern Anatolia region of Turkey where Brucella is frequently seen, we evaluated 148 children's cases that were followed up with a brucellosis diagnosis in a 2nd stage children's hospital. Brucella is endemically frequently observed in the Eastern and Southeastern Anatolia regions in Turkey [6,7]. Brucella can affect people from all age groups. It has been reported that Brucella infection is mostly observed in the group aged 15-35 years in the endemic regions. Brucella infection was more frequent in children under 14 years of age [8]. The median age of the patients in our study was 10.6, and 85.1% of the patients were children under the age of 14. It was found that infection more frequently developed in male children which suggested that male children could have more contact with animals. There were studies in the literature which complied with our study, stating that Brucella developed more frequently in male children [9,10,11].

The most common cause of Brucella in children is the consumption of unpasteurized dairy products. In our study, 64.1% of the patients had a history of fresh cheese consumption, and 4.1% of the patients had a history of raw milk consumption. In the previous studies made in Turkey, the history of consumption of unpasteurized milk and dairy products in children was reported between 51.6% - 71.1% [9,12]. Reducing the consumption of non-pasteurized milk and dairy products in children is an important way of preventing the disease. In addition, 16.9% of the patients had a history of being in contact with a brucellosis diagnosed animal. When the history of having a sick animal in the house in 16.9% of the patients in the endemic region is considered, it is extremely important to inform the families.

Table 2. Admission symptoms of the patients

Admission symptom of patients	n	%
Fever	88	59.5
Joint Pain	61	41.2
Leg pain	57	38.5
Fatigue	35	23.6
Weight loss	26	17.6
Chills and shivering	22	14.9
Headache	19	12.8
Abdominal pain	16	10.8
Night sweating	11	7.4
Nausea	2	1.4
Vomiting	1	0.7
Testicular pain	1	0.7

Table 3. Laboratory characteristics of patients diagnosed with brucella

Laboratory values	Mean ±SD	Minimum-Maximum
Leucocyte /(mm³)	6678±2124	2100-13300
Hematocrit (%)	36.9±3.9	25.6-46.3
Thrombocyte/(mm³)	291.776±83.000	44000-541000
Sedimentation (mm/hour)	29.2±22.7	1-107
CRP (mg/dl)	10.1±11.2	0.02-78.6
ALT (IU/L)	52.4±89.3	1-751

Table 4. Complications developed due to brucella in the participant patients of the study

Developed complication	Number of patients evaluated (n)	n	%
Neutropenia	125	10	8
Anemia	125	27	21.6
Thrombocytopenia	125	6	4.8
Thrombocytosis	125	1	0.8
Asymptomatic transaminases increase	126	27	21.4
Arthritis	148	10	6.7
Sacroiliitis	148	6	4
Bursitis	148	1	0.67
Spondylitis	148	1	0.67
Epididymitis	148	1	0.67

Although the disease can be observed throughout the year in Turkey, it is more frequent in the spring and summer months when sheep breed and cheese production increases [13,14]. A similar series of adult cases reported from Iran have also stated that brucellosis was more frequently observed during the spring and summer months [15]. Our study also determined Brucella infection to be at the highest rate specifically during the summer months.

Due to the common living area and the common food consumption, the risk of Brucella is increased in family members of index case family members. In previous studies, with the scanning of family members, the seropositivity rate was reported as 9.5% -36.8% and it was suggested that family members should be examined for Brucella [16,17]. In our study, brucella history rate of patients' family members was found to be 39.2%. The high incidence of Brucella infection in family members may be due to the fact that the study was conducted in an endemic region. This rate reflects the history of previous Brucella infection and suggests that higher seropositivity may be found after scanning.

The most common admission complaints in our study were: fever (59.5%) followed by arthralgias (41.2%), leg pain (38.5%) and fatigue (23%). The most frequent physical examination findings were: pallor (21.6%), splenomegaly (15.5%) and hepatomegaly (4.7%). Brucella can cause infection in all organs and tissues causing very different symptoms and findings. Acute Brucella infection typically presents with fever, fatigue, sweating, weight loss, and joint pain. In the studies conducted, the incidence of fever in children with Brucella infection was reported between 55.3-91% and arthralgia was reported between 49.5-87.8% [10,18,19,20].

Laboratory changes due to bone marrow involvement were detected in 35% of our patients. The most frequent of hematologic manifestations was anemia (21.6%) and neutropenia was found in 8%, thrombocytopenia in 4.8% and thrombocytosis in 0.8% of the patients. However, no serious hematologic complications such as hemorrhage or coagulation disorder were detected in any patient. Hematological manifestations are frequently observed in Brucella. While mild anemia and leucopenia are more common, thrombocytopenia and pancytopenia are less common. Pancytopenia is less common in children than in adults. In a study in China where 590 brucellosis diagnosed pediatric patients were included, anemia was detected in 45.3%, lymphocytosis in 33.3%, thrombocytopenia in 19.9%, leukopenia in 9.3% and leukocytosis in 15.4% of the patients [21]. In a study conducted in our country, 90 patients diagnosed with brucellosis were evaluated and 26.7% of the patients were reported to have anemia, 10% leukopenia, 5.6% thrombocytosis and 3.3% thrombocytopenia [9].

Hepatic involvement is one of the common complications of Brucella, but symptomatic hepatitis is rare. Liver and spleen enlargement with mild elevation of liver enzyme levels can be detected in approximately 50% of all patients with brucellosis [11,13]. In this study, asymptomatic transaminase increase was detected in 21.4% of the cases, and hepatomegaly detected in 4.7% of the cases.

The most common local disease due to Brucella is osteoarticular involvement. Osteoarticular brucellosis includes peripheral arthritis, sacroiliitis, spondylitis, tenosynovitis, bursitis, and osteomyelitis. The most common involved regions are large or medium-sized peripheral joints, sacroiliac joints, and spinal region. Osteoarticular involvement in children is reported as 6-74% in a very different range [9,10,13,22]. In this study, osteoarticular involvement was found in 12.1% of the patients. The peripheral joint involvement rate of these patients was 55.5% and was in compliance with the literature. When all the cases were examined, the rates were detected as peripheral arthritis 6.7%, sacroiliitis 4%, bursitis 0.67%, spondylitis 0.67%. Peripheral arthritis was found to develop more frequently in hip, knee and ankle joints. There was no statistical difference in terms of demographic, clinical, and laboratory data except for the sedimentation rate in patients with osteoarthritic involvement compared to non-involvement patients. Sedimentation values were significantly higher in patients with osteoarthritic involvement. In a study which evaluated 196 children and adult patients with osteoarticular involvement, the sedimentation value was detected higher in patients with osteoarticular involvement but no statistical difference was detected in the other laboratory data [5].

A definite diagnosis of Brucella infection is made by the isolation of Brusella spp from blood culture, other body fluids or tissue cultures. Studies have reported very different results for blood culture positivity rates such as 7-74.3% [2,23,24]. Since isolation of Brucella spp in culture is not always possible, serologic tests have a very important role in diagnosis of patients who are clinically suspected for Brucella. Therefore, serum agglutination test (standard tube agglutination) and enzyme- linked immunosorbent assay (ELISA) are the most commonly used methods. If the standard tube agglutination test is > 1:160, it is considered positive. However, especially in endemic regions, a single positive value does not indicate a Brucella infection. The premium serological explanation of brucellosis is affirmation by a fourfold or higher progress in Brucella agglutination titer between acute – and convalescent-phase serum varieties gathered ≥ 2 weeks aside and researched at the same laboratory [2]. In our study, only one patient's rose bengal and standard tube agglutination test was negative, and *B. melitensis* was positive in the bone marrow culture of this patient. In this study, blood cultures from 93 patients were taken and *B. melitensis* was positive in the blood cultures of 72% of the patients. Our blood culture rate was higher than the values reported in the literature. The early stage of brucellosis was suspected due to being at an endemic region , and direct communication with the microbiologist might explain the high rates of blood culture positivity. Brucella leukocyte count, CRP and sedimentation values can usually be normal or slightly increased [2,25]. In our study, none of the patients had leukocytosis, and CRP and sedimentation values were mildly high.

In childhood brucellosis, treatment with cotrimoxazole plus rifampin or doxycycline plus rifampin, according to the age of the patients for six weeks, is a competent treatment with low relapse rates. Tetracycline group medications are not recommended for children under eight years of age due to the color change in the teeth, and are substituted with TMP-SMX group drugs. This combination treatment is highly effective [2,10,23,26]. In this study, the patients were treated in accordance with the recommendations and 94.5% have received treatment for six weeks. Treatment of patients with sacroiliitis and spondylitis continued until symptoms improved and lasted at least 12 weeks. At the end of the treatment, 2 patients (1.3%) had relapsed and

relapsed patients were found to have poor drug compliance. It was found that 5.4% of the patients who participated in the study had previously been diagnosed with brucella and had relapsed due to inadequate treatment. Relapse rates in children are related to the duration of treatment and selected antibiotic regimens. Relapse rates in the literature as a result of six weeks of treatment have been reported to be between 5% and 12% [8,9,27]. Studies conducted in our country have reported relapse rates in children after 6 weeks of treatment between -2.1% and 6.6% [12,28,29]. We found a quite low relapse rate (1.3%) in this study. We think that the low relapse rate is related to the patient's close follow-up as well as adequate treatment for the patient, and to the patient's compliance with the drug and providing detailed information about the disease to their families.

Conclusion

Non-specific symptoms and findings, difficulty in isolating the agent in culture, and low specificity of serologic tests in endemic areas make brucellosis difficult disease to diagnose. Brucella can lead to diseases in all organs and tissues and is a major cause of morbidity in children. The use of multiple medications in the treatment of brucellosis and long treatment duration reduces patient compliance, and close follow-up of the patients is important. In this study, a family history of previous Brucella rate was high. Early diagnosis and treatment, prevention of the development of complications can be provided by family scanning. Brucellosis is still an endemic disease in our country. We also think that protective measures in animals and the treatment of sick animals are extremely important for the eradication of the disease.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

Funding: None

Conflict of interest

None of the authors received any type of financial support that could be considered potential conflict of interest regarding the manuscript or its submission.

References

1. Pappas G, Akritidis N, Bosilkovski M, Tsianos E. Brucellosis. N Engl J Med. 2005;352:2325–36.
2. Young EJ. Brucella Species (Brucellosis). In: Long SS, Pickering LK, Prober CG. 3rd edition Principles and Practice of Pediatric Infectious Diseases. Churchill Livingstone; 2009.p.855-8.
3. Pappas G, Papadimitriou P, Akritidis N, Christou L, Tsianos EV. The new global map of human brucellosis. Lancet Infect Dis. 2006; 6: 91–9.
4. Alton GG, Jones LM, Pietz DE. Laboratory techniques in brucellosis. Monogr. Ser. World Health Organ. 1975; 55: 1-163.
5. Bosilkovski M, Krteva L, Caparoska S, Dimzova M. Osteoarticular involvementin brucellosis: Study of 196 cases in the Republic of Macedonia. Croatian Medical Journal. 2004; 45: 727-33.
6. Yumuk Z, O'Callaghan D. Brucellosis in Turkey—an overview. Int J Infect Dis. 2012; 16: 228–35.
7. Çetin ET, Çoral B, Bilgiç A, Bilgehan E, Sipahioğlu U, Gürel M. Türkiye'de insanda bruselloz insidansının saptanması. Doğa- Türk J Med Sci. 1990; 14: 324-34.
8. Bosilkovski M, Krteva L, Caparoska S, Labacevski N, Petrovski M. Childhood brucellosis: Review of 317 cases. Asian Pac J. Trop. Med. 2015; 8: 1027-32.
9. Tanır G, Tüfekçi SB, Tuygun N. Presentation, complications, and treatment outcome of brucellosis in Turkish children. Pediatrics International. 2009; 51: 114–19.
10. Al-Shaalan M, Memish ZA, Al Mahmoud S, A. Alomari A, Khan MY, Maha Almuneef M, et al. Brucellosis in children: Clinical observations in 115 cases. Int J Infec Dis. 2002; 6: 182-6.
11. Tsolia M, Drakonaki S, Messaritaki A, Farmakakis T, Kostaki M, Tsapra H,et al. Clinical features, complications and treatment outcome of childhood brucellosis in central Greece. J Infect. 2002; 44: 257-62.
12. Çelebi S, Hacımustafaoğlu M, Demirtaş F, Salı E, Gül Ü, Özel M. Çocukluk çağında bruselloz. J Pediatr Inf. 2011; 5: 59-62.
13. Gür A, Geyik MF, Dikici B, Nas K, Çevik R, Saraç J et al. Complications of brucellosis in different age groups: a study of 283 cases in Southeastern Anatolia of Turkey. Yonsei Med J. 2003; 44: 33-44.
14. Göktaş P. Erzincan bölgesinde bruselloz olgularında artış. İnfeksiyon Dergisi. 1990; 4: 475-81.
15. Hasanjani Roushan MR, Mohrez M, Smailnejad Gangi SM, Solemani Amiri MJ, Hajiahmadi M. Epidemiological features and clinical manifestations in 469 adult patients with brucellosis in Babol, Northern Iran. Epidemiol Infect. 2004; 132: 1109–14.
16. Çiftdoğan DY, Aslan S. Unrecognized pediatric and adult family members of children with acute brucellosis. Braz J Infect Dis. 2017; 21: 520-4.
17. Ismailova R, Mody R, Abdullayev R, Amirova K, Jabbarova L, Ustun N, et al. Screening of household family members of brucellosis cases and neighboring community members in Azerbaijan. Am J Trop Med Hyg. 2013; 88: 929-31.
18. Al-Eissa YA, Kambal AM, al-Nasser MN, aL-Habib SA, aL-Fawaz JM, aL-Zamil FA. Childhood brucellosis: a study of 102 cases. Pediatr Infect Dis J. 1990; 9: 74.
19. Caksen H, Arslan S, Faik Onor A, Cesur Y, Ceylan A, Atas B, et al. Childhood brucellosis is still a severe problem in the eastern region of Turkey. Trop Doct. 2002; 32: 91-2.
20. Roushan MR, Ahmadi SA, Gangi SM, Janmohammadi N, Amiri MJ. Childhood brucellosis in Babol, Iran. Trop Doct. 2005; 35: 229-31.
21. Jia B, Zhang F, Lu Y, Zhang W, Li J, Zhang Y, et al. The clinical features of 590 patients with brucellosis in Xinjiang, China with the emphasis on the treatment of complications. Plos Negl. Trop Dis. 2017; 11(5): DOI: doi: 10.1371/journal.pntd.0005577.
22. El-desouki M. Skeletal brucellosis: assessment with bone scintigraphy. Radiology. 1991;181: 415–18.
23. Mantur BG, Akki AS, Mangalgi SS, Patil SV, Gobbur RH, Peerapur BV. Childhood brucellosis: A microbiological, epidemiological and clinical study. J Trop Pediatr. 2004; 50: 153-7.
24. Corbel MJ. Microbiological aspects of brucellosis. Saudi Med J. 1993; 14: 489-502.
25. Kurtaran B, Candevir A, Inal AS, Komur S, Akyıldız O, Saltoğlu N, et al. Clinical appearance of brucellosis in adults: fourteen years of experience. Turk J Med Sci. 2012; 42: 497-505.
26. Hasanjani Roushan MR, Mohraz M, Janmohammadi N, Hajiahmadi M. Efficacy of cotrimoxazole and rifampin for 6 or 8 weeks of therapy in childhood brucellosis. Pediatr Infect Dis J. 2006; 25: 544-5.
27. Hall WH. Modern chemotherapy for brucellosis in humans. Rev Infect Dis 1990; 12: 1060-99.
28. Öncel EK, Özsürekçi Y, Cengiz AB, Kara A, Ceyhan M, Çelik M et al. Çocukluk çağında bruselloz: Hacettepe Üniversitesi deneyimi. Çocuk Sağlığı ve Hastalıkları Dergisi. 2011; 54: 135-41.
29. Yoldaş T, Tezer H, Parlakay AO, Saylı TR. Clinical and laboratory findings of 97 pediatric brucellosis patients in central Turkey. Journal of microbiology, Immunology and Infection. 2015; 48: 446-449.

How to cite this article:
Gündeşlioğlu ÖÖ. Brucella infection in children: Evaluation of 148 pediatric patients. J Clin Anal Med 2019;10(1): 99-103.